DOCUMENT RESUME

ED 226 656 HE 015 924

AUTHOR	Snortland, Robert K.
TITLE	An Individualized Teaching Approach: "Audio-Tutorial." College Teaching Monograph.
INSTITUTION	North Dakota Univ., Grand Forks. Office of Instructional Development.
PUB DATE	82
NOTE	13p.
AVAILABLE FROM	North Dakota University, Office of Instructional Development, Box 8161, University Station, Grand Forks, ND 58202.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Audiovisual Aids; *Autoinstructional Aids; *College Instruction; Comparative Analysis; *Engineering Graphics; *Flexible Scheduling; Higher Education; *Individualized Instruction; Institutional Research; Learning Laboratories; Nontraditional Education; Student Attitudes; Teaching Methods; Time Factors (Learning)
IDENTIFIERS	*University of North Dakota

ABSTRACT

The use of the audio-tutorial (A-T) individualized teaching approach at the University of North Dakota is described. This approach, which was based on the work of S. N. Postlethwait and the philosophy of B. F. Skinner and Benjamin Bloom, attempts to match an instructional strategy with the needs of the learners. The modified A-T graphics approach was designed to increase scheduling flexibility, reduce learning time, allow for individual differences, and reduce costs. The effectiveness of the A-T approach in basic engineering graphics was compared to the traditional lecture-lab (L-L) approach. The A-T group consisted of 84 students, mainly new freshmen majoring in engineering. While the course content was identical, the L-L approach was more structured. Students' attitudes about the approaches were determined by pre- and post-tests. Competitiveness, procrastination, attrition, and performance were assessed. Findings include the following: students with previous drawing and visualization experience benefited most from the individualized approach; the A-T approach resulted in significant work-time savings for students; and many A-T students could not master the additional self-discipline required to maintain a steady pace. (SW)

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COLLEGE TEACHING MONOGRAPH

An Individualized Teaching Approach: "Audio-Tutorial"

by

Robert K. Snortland
University of North Dakota

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COLLEGE TEACHING MONOGRAPHS

This series of monographs has been produced to bring attention to significant ideas and developments in college teaching. The series allows college teachers at the University of North Dakota and elsewhere to share their insights and their experimentation with approaches to college level learning and instruction.

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An Individualized Teaching Approach:
"Audio-Tutorial"

by
Robert K. Snortland
University of North Dakota

Problems often indicate a need for change. Specific problems for the student, the instructor, and the institution contributed to the development at UND of an individualized teaching approach to basic engineering graphics, called Audio-Tutorial, or A-T graphics.

The first problem, one often faced by college-level teachers of any subject, is created by the varied interests and backgrounds of the students who are required to take the course. The range of students' preparedness and the degree of their motivation is extremely wide. While the traditional L-L (lecture-lab) approach to teaching and learning the graphic language had worked out quite well for about half of the beginning engineering students, the tight structure and uniformity in the pace proved to be less than desirable for others. These others clearly needed a choice of teaching approaches.

Second, the tight class structure and inflexibility in scheduling the labs was presenting the institution with problems as well. As enrollments increased, lab space became more limited, and due to the economic constraints on the institution, additional faculty members were not added to keep pace with the increasing number of students. A more cost-effective method for teaching basic engineering graphics was needed.

Finally, I as the instructor found myself faced with the problem that has been labeled "Teacher Burnout." Although I had taught graphics quite effectively for a number of years by using the traditional L-L format, the

repetition of lecturing over the same basic material two and even three times the same day was getting me down. Things were going stale.

The need for an alternative approach to teaching and learning basic engineering graphics was obvious. The modified A-T format which I shall describe in this monograph provides a choice of teaching methods, more freedom for student and teacher, and a way to work with larger enrollments, thereby better serving the needs of the students, the instructor, and the institution.

BACKGROUND

The Audio-Tutorial format was developed in 1961 by S. N. Postlethwait at Purdue University. His purposes were to find an improved method of teaching botany to a larger number of college students and to effectively assist the students who possessed only limited backgrounds in the subject. Since that time, the A-T method has been modified and adopted for use with a variety of subjects, class sizes, and types of institutions.

The design of my approach was based on Postlethwait's ideas, but I was also influenced by the philosophy and psychology of B. F. Skinner and Benjamin Bloom. Mine was an attempt to match an instructional strategy with the needs of the learners, with the following two premises clearly understood at the outset:

(1) The A-T approach was not designed as an easier way to teach, but was intended to make learning more meaningful for both the students and the teacher.

(2) The most important ingredients in A-T teaching and learning are the people involved, namely the teacher, tutors, and the students. The machines, tapes, slides, books, study guides, and drawing assignments are

only tools which may help to facilitate the learning, but they were never meant to take the place of the teacher.

The A-T design should permit the teacher more time to help those students who really need the help, since many of the students are off and running on their own power. But, the A-T approach will not make a poor or mediocre teacher any better. On the contrary, it may even lead to a lesser degree of effectiveness if the teacher expects to sit back and let the program run itself.

My general objective in designing and implementing the modified A-T graphics approach was to improve the climate for learning by creating an individualized and more positive learning environment. Specific objectives included increased flexibility in scheduling, increased learning in less time, greater faculty satisfaction, allowances for individual differences in preparedness, and long term reduction in institutional costs.

L-L GRAPHICS AND A-T GRAPHICS COMPARED

In the fall of 1978, funded by a grant from the UND Committee on Instructional Development (now the Faculty Instructional Development Committee), I began using the A-T approach in Basic Engineering Graphics. To test its effectiveness, I created an experiment comparing A-T with the traditional L-L approach.

The course content of both the experimental A-T and the control L-L sections was identical. In structure, however, the sections differed quite dramatically. Compared to the A-T sections, the L-L sections were highly structured. The L-L graphics course met two days a week, two hours each time. All students were expected to attend on a regular basis, and most of the work was required to be completed in the lab during the scheduled

time. The time frame for completion of the assigned drawings was rigid and self-pacing was not permitted. In addition to the mid-term and final exams, two unit exams were required. As the instructor for one of the L-L sections, I was present during most of the scheduled lab time, and approximately one hour each week was spent lecturing about the subject matter.

The A-T graphics course met only one hour a week, with the lab times "to be arranged." All course testing (mid-term and final exams) and the research testing was done during this general meeting. Since my office was located near the self-study center and the design labs, my students could stop by and visit with me at any time of the week about anything they wished, whether it be their graphics assignments, the last exam, or other concerns unrelated to engineering graphics.

The experimental A-T group consisted of 84 students, most of whom were incoming freshmen majoring in engineering. The general format was explained to them at pre-registration, and although some enrolled in the course because of scheduling problems with L-L sections, most were there by choice.

The majority of activity in A-T graphics took place in the self-study center and in the drafting and design lab. The self-study center had six individual study carrels, four of which were equipped with synchronized conversational audio-tape and slide projectors. The room was open during the regular school hours, and the A-T students were encouraged to view the 15-20 minute tape-slide presentations whenever they felt it would be helpful to them. This was the feature of the program which replaced the traditional lecture, but it was not a required activity.

Each A-T student had a file folder in a cabinet located in the self-study center. This was a means for daily communication between the students and

myself; graded drawing plates were returned to them in their file folders, along with any pertinent comments or questions. General announcements were placed on the large whiteboard in the self-study center, and occasionally sketches of the more difficult graphics problems were drawn on the whiteboard to assist the students in analysis and visualization of the problems assigned for the required units of study.

Like the self-study center, the design laboratory was open all day during regular school hours. The A-T students had the freedom to work there on the assigned sketching and drafting plates, whenever they wished for as long as they desired. In addition to myself, an engineering student tutor was generally available to assist the students when questions arose. Some peer tutoring also took place in the design labs with students helping one another and discussing the problems in small groups, informally.

RESULTS

In an attempt to find out how the students' attitudes and feelings about graphics and engineering might have been affected by each of the two different instructional approaches, I administered a series of "attitudinal" type pre-and post-tests. While some of the results were inconclusive, a few were significant and deserve reporting.

In the areas of cooperativeness vs. competitiveness, I found that the A-T students began the semester feeling somewhat more competitive, and cooperative, than the L-L group. The post-tests showed that the A-T students' feelings of competitiveness were reduced (9%); the L-L students' feelings did not change over the term. The A-T students' feelings of cooperativeness increased (23%) during the semester, as did those of L-L students (9%).

In the area of procrastination, it was interesting that 54% of the students pre-tested in the A-T group indicated they had a tendency to put

things off, as compared with only 39% of the L-L students pre-tested. Post-test results for both groups showed that their semester's graphics experience increased students' belief in a tendency to procrastinate (57% in both groups).

The course content pre-tests proved valuable. Well-prepared students could by-pass certain or all of the required units of study, depending on the pre-test score. Students enrolled in the L-L sections were not offered the by-pass option. It is interesting that many students who earned the by-pass still chose to complete the assigned work, in hopes of a higher grade.

The rate of attrition of the experimental A-T graphics course compared quite favorably with that in the L-L approach. The majority of students who withdrew from both the A-T and the L-L courses in graphics did so either within the first two weeks of the semester or soon after the mid-term exam.

In the area of student performance, there was no significant difference in the amount of subject matter learned. Although the A-T students scored slightly lower than the L-L students on the exams, their final course grades were slightly higher, because they scored higher on the drawings, which constituted a greater percentage of their grade. The A-T students also had the opportunity to earn bonus points for submitting drawings promptly.

Possibly the most significant results were in the area of time effectiveness. I asked all of the students to indicate the average number of hours they had spent per week on the basic graphics course, including the time spent on completing the drawing assignments, the time spent in meetings, and their study time. Reports indicated that 35% of the A-T students spent only one to three hours a week; none of the L-L students got by that cheaply! Between four and five hours each week were spent by 54% of the A-T students, as compared to only 35% of the L-L students. Only 12% of the A-T students admitted that they had spent over six hours a week on the

two-semester credit hour course in graphics, but 65% of the L-L students said it had taken them that much time or longer. Clearly, the work in the A-T section was being done more efficiently and economically.

ECONOMIC ANALYSIS

In view of the high initial cost of materials necessary for implementing the program, an accurate and reliable cost analysis was not possible. Therefore, at first I had only a sketchy idea as to how many additional students could be taught effectively via A-T as compared to the L-L approach. More recent signs and numbers, however, point to a possible 25% to 50% savings for the institution over a ten-year period. I believe that I can effectively assist a much larger number of students in learning the subject matter each semester by employing the modified A-T approach but in doing so, I will also need a correspondingly greater number of qualified undergraduate tutors and checkers as assistants in order to keep the rate of attrition from increasing at the same pace as the additional enrollment. The real savings, therefore, may be in the difference of salary rates paid to the tutors and checkers as compared to the salaries needed to attract professional faculty for staffing the L-L sections. Also, the availability of qualified engineering faculty is becoming more limited each year. This factor may become as important as economics and improved instruction in considering an A-T type approach in the near future.

CONCLUSIONS

Several general conclusions may be drawn from this experiment with the Audio-Tutorial approach. Generally, the students with previous drawing and visualization experience were able to endure and prosper from the individualized approach and enjoy it to a greater degree than those who began the course with little or no prior training in the graphics language.

Second, the A-T approach produced significant work-time savings. Some of the differences in this area can be attributed to the by-pass option offered to A-T students, but it appears that there were other reasons as well. Could it be that the time required of the L-L students to listen to lectures each week was ill spent and unnecessary? Since the A-T students accomplished basically the same results in considerably less time, it made the value of the lectures look questionable.

Third, self-pacing was a definite problem. While the main advantages of A-T graphics proved to be the flexibility and ease of scheduling, many students were not ready to master the additional self-discipline required in order to maintain a steady pace. Numerous problems for myself and for the students were brought about by what I later found to be too liberal a policy in regard to the due dates for the students' work. The program is now more instructor-paced, which has not totally eliminated the problem, but has definitely alleviated it.

Finally, the fact that one-fourth of the A-T students said they could have used more structure and one-third of the L-L students felt they may not have done as well without it should remind us that the A-T graphics approach is not for everyone. Since many freshmen students are not ready for the additional self-discipline required of them in the A-T format, the choice of either a structured approach or an individualized approach should always remain open, if the institution can justify it on a cost-effective basis.

At this point, a word of caution regarding the old "Man vs. Machines" argument must be offered. There is a danger with this teaching method in the thinking that the machines can pretty well take over and thereby reduce the need for well qualified and professional teachers. Even though an efficient, workable, and effective teaching program is fairly well in place and de-bugged,

it will still be essential to have a core of dedicated teachers around to keep the system oiled and do the many "in house" things necessary to maintain the credibility and integrity of the system as originally designed. There are so many factors which affect the motivation of the students, checkers, tutors, and teachers, that the machines by themselves, without human support, would not only be ineffective, but very likely disastrous.

One final question must be asked. Was it all worth it? The answer is an unequivocal and resounding "yes". The A-T approach offers certain features advantageous to the students, the teacher, and the institution. The added flexibility in scheduling is beneficial to all, and the reduction of repetition for the teacher (the machines do the boring work) is most important as a means of reducing teacher burnout. The psychological advantages, plus the others listed as objectives earlier in this report, all serve as barometers of success. These prove that the A-T graphics approach will stand the test of time and prove to be even more worthwhile in future years.

Biographical Note

Professor Snortland has been teaching engineering graphics at the University of North Dakota since 1963. Prior to that date he taught technical drawing at the secondary school level in California and also worked as a detail and layout draftsman in the aerospace industry. His bachelors and masters degrees are in industrial education and were earned from the University of North Dakota. Post masters work includes a year at Kansas State University studying in the area of college student personnel work, a year at Purdue University studying educational technology and individualized instructional design, and a workshop in Computer Graphics at the University of Texas.

Professor Snortland welcomes any questions and discussions regarding the A-T approach. Anyone wishing more detailed information may contact him at the Department of Mechanical Engineering, University of North Dakota.